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Wind erosion as a footprint of evolving Sahelian agro-pastoral systems: a case study in southwestern Niger

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Wind erosion is a key land degradation process that impacts agricultural sustainability in drylands like the Sahel. In such populated areas, agro-pastoral activities significantly affect soil susceptibility to wind erosion, especially through modification of protective vegetation cover. Over the last decades, Sahelian demographic growth induced a large cropland expansion along with changes in agrarian practices. At the same time, climate variability has been very large in the Sahel, with severe droughts and large fluctuations in annual rainfall, impacting crop production and ground cover. The dual stressors of demographic growth and highly variable rainfall potentially increased wind erosion and accelerated its feedbacks on agricultural production.

This work investigates wind erosion responses to scenarios of change in agro-pastoral practices for a Sahelian study site in southwestern Niger. We use an ecological state change framework to provide context for assessing impacts of land use and management changes on aeolian sediment transport rates. Relying on local measurements of meteorological data and on simulations of vegetation cover and wind erosion, agro-pastoral practices are modelled for ecological sites (plant-soil complexes) typical of the area. The practices, derived from literature review and from expert knowledge, account for fallow shortening, change in cultivars, manuring, and crop residue management, that are typical in southwestern Niger.

The simulated wind erosion fluxes are analyzed as integrated footprints of evolving agro-pastoral activities under a fast-growing demographic pressure and a large climate variability. These results provide a basis for investigating impacts of future land use, land cover and land management change on wind erosion in the Sahel.